LE CHATELIER'S
PYROMETER

FOR MEASURING TEMPERATURES

BETWEEN 0-1600° CELSIUS

EQUAL TO

2920° FAHRENHEIT

CONSTRUCTED ACCORDING TO THE DIRECTIONS OF THE

ROYAL PHYSICAL TECHNICAL INSTITUTE

CHARLOTTENBURG, NEAR BERLIN

BY

W. C. HERAEUS PLATINUM WORKS

HANAU, GERMANY

REPRESENTATIVE

CHARLES ENGELHARD

41 CORTLANDT STREET

NEW YORK

ECONOMY DRYER & OIL BURNING CO.,
St. Louis, Mo.

THE scarcity of reliable instruments for measuring high temperatures, and the demand in numerous industries for such devices, prompted the Royal Physical Technical Institute, at Charlottenburg, to intrust to Mr. W. C. Heraeus the manufacture of an apparatus according to the principle of Professor Le Chatelier, of Paris.

The aim was to produce an instrument which would meet all modern requirements, and the "*Le Chatelier Pyrometer,*" as it is now manufactured and placed on the market by the above-named and well-known firm of Platinum refiners, is the result of these endeavors.

The ready sale which this instrument enjoys is a sufficient proof of its efficiency, and its successful application is further substantiated by numerous testimonials, of which a few are added at the end of this pamphlet.

The urgent need of an apparatus of this description is demonstrated by its extensive introduction in establishments for the manufacture of Gas, Chemicals, Sugar, Terra Cotta, Stoneware, Porcelain, Fire-brick, Cement, Accumulators, Incandescent Lamps, Cartridges and Ammunition, Anilin, Glass, Steel, Iron, etc., and further by its use in factories of Electro-Technical Instruments, Roll Foundries, Gray and Malleable Iron Foundries, Machine and Tool Works, Boiler Inspections, and Schools and Colleges.

The principle involved in the construction of this instrument is the conversion of heat into an electric current and determining

Section, Natural Size of B

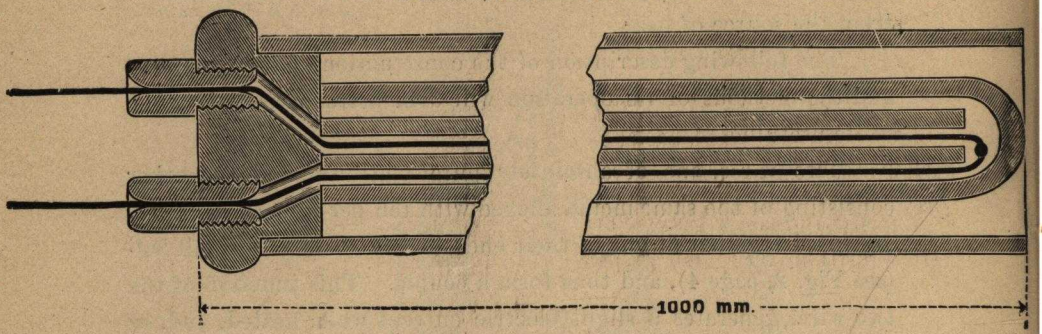


FIGURE 2.

$\frac{1}{6}$ Natural Size

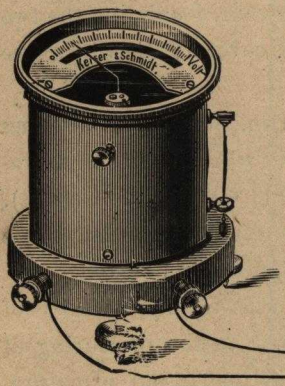
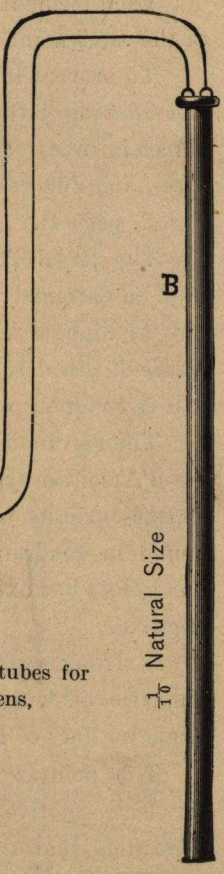


FIGURE 3.



Complete Pyrometer outfit with porcelain protection tubes for use in connection with furnaces, flues, kilns, ovens, etc., of all descriptions.

while the second scale gives direct readings of the degrees of temperature.

On the side of the cylindrical casing of each instrument there is provided an adjustable thumb-screw, which secures the armature, thus avoiding the breaking of its delicate suspension wire, while in transit. This screw should always be carefully secured before moving the instrument.

Adjusting screws in the base allow the instrument to be placed readily in a horizontal position.

A switch on the base of the galvanometer serves for the purpose of breaking the thermo-current.

The wire clamp-screws on the galvanometer are marked + and —, respectively. The clamp marked + should be connected to the platinum rhodium wire and the one marked — to the platinum wire. The platinum is the softer one of the two ends.

The knob at the upper end of the cylindrical casing is connected to the scales and permits their adjustment, or, indirectly, an adjustment of the pointer to the zero mark.

The method of the application of the apparatus will be easily understood from the above description.

The end of the tube containing the two wires is exposed to the temperature to be measured, and the free ends of the wires are connected to the binding-posts on the galvanometer (see Fig. 3, page 4). Or, if desired, the galvanometer may be placed at any distance from the element and insulated copper wires may be used to connect both. This wire should be No. 12 American or Brown & Sharpe Gauge, for a distance of 300 feet, or at any distance, the resistance of the wire used should be no more than one ohm.

As soon as the temperature of the thermo-element has risen to that of its surroundings, the deflection of the pointer along the scales will cease.

The temperature surrounding the junction of the element wires with the copper conductors should be thirty-two degrees Fahrenheit to give correct readings. Small variations therefrom, for instance, if it should be the ordinary temperature of dwellings (sixty-five degrees Fahrenheit), will scarcely be significant for the

application of the Pyrometer in ordinary practice; however, it is essential to keep the cold junction of the thermo couple at freezing point, if it is necessary to determine the exact temperature of a furnace or other source of heat, by direct readings of the galvanometer.

We are fully aware that the successful application of this instrument in practice requires, in some cases, special contrivances (see Fig. 1, page 2) to adopt itself to the various purposes it is intended for, and in such instances we willingly offer our services. A careful study of the subject, close observation and experience in this branch of science, enables us to be oftentimes of material assistance to our patrons.

We invite, and we will promptly answer all matters pertaining to Pyrometry.

We will give cheerfully the minutest instructions which will enable the most inexperienced to install and use the instrument.

For the convenience of our patrons we have added in this edition a scale for the comparison of degrees Fahrenheit and centigrade (Fig. 4, page 7), a reprint of the galvanometer dial, representing the relation between degrees of temperature and millivolts (Fig. 5, page 8), and further tables of the melting and boiling points of various substances, besides other valuable data which may prove useful in practice.

W. C. HERAEUS, Hanau.

Representative,

CHARLES ENGELHARD,

41 Cortlandt St., New York.

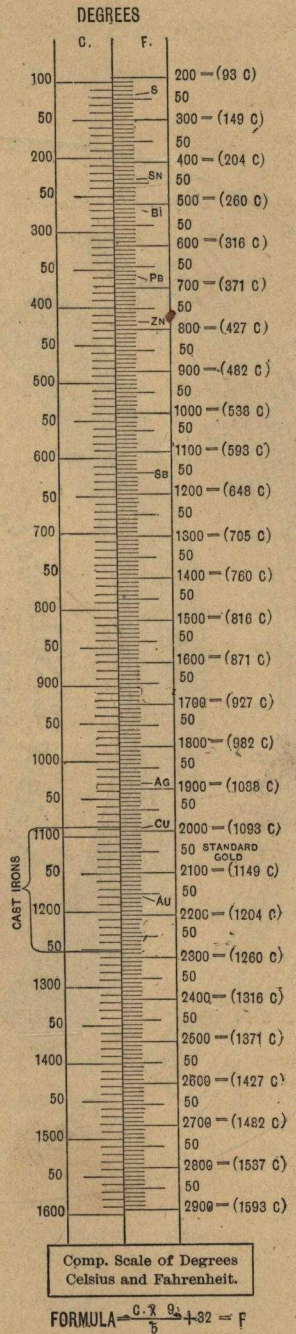

DEGREES
C.
F.
100
50
200
50
300
50
400
50
500
50
600
50
700
50
800
50
900
50
1000
50
1100
50
1200
50
1300
50
1400
50
1500
50
1600
S
SN
BI
PB
ZN
SB
AG
CU
AU
CAST IRONS
200 — (93 C)
300 — (149 C)
400 — (204 C)
500 — (260 C)
600 — (316 C)
700 — (371 C)
800 — (427 C)
900 — (482 C)
1000 — (538 C)
1100 — (593 C)
1200 — (648 C)
1300 — (705 C)
1400 — (760 C)
1500 — (816 C)
1600 — (871 C)
1700 — (927 C)
1800 — (982 C)
1900 — (1038 C)
2000 — (1093 C)
STANDARD GOLD
2100 — (1149 C)
2200 — (1204 C)
2300 — (1260 C)
2400 — (1316 C)
2500 — (1371 C)
2600 — (1427 C)
2700 — (1482 C)
2800 — (1537 C)
2900 — (1593 C)
Comp. Scale of Degrees Celsius and Fahrenheit.
FORMULA $\frac{C. \times 9}{5} + 32 = F$

FIGURE 4.

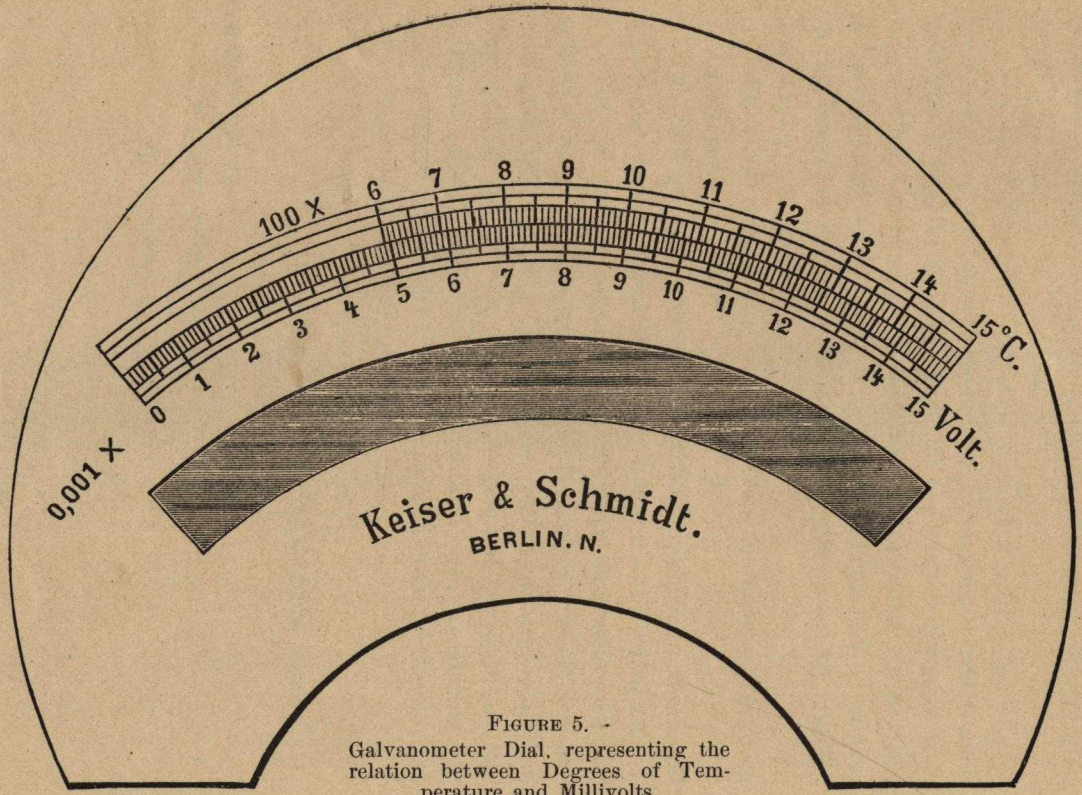


FIGURE 5. -
Galvanometer Dial, representing the relation between Degrees of Temperature and Millivolts.

Temperature Determinations by Prof. Roberts Austen.

	°C.		°F.
1. GOLD MELTING (Royal Mint).			
Standard alloy, pouring into moulds	1180	..	2156
Standard alloy, pouring into moulds, by thermo-couple	1147	..	2097
Annealing blanks for coinage, temperature of annealing chamber	890	..	1634
2. SILVER MELTING (Royal Mint).			
Standard alloy, pouring into mould	980	..	1796
3. STEEL MELTING (10-ton open hearth furnace, Woolwich Arsenal).			
Steel, 0.3% carbon, pouring into ladle	1645	..	2993
" " " " " large mould	1580	..	2876
Reheating furnace, temperature of interior	930	..	1706
Cupola furnace, temperature No. 2, cast-iron pouring into ladle	1600	..	2912

Determinations by Prof. Le Chatelier.

	°C.		°F.
4. SIX-TON CONVERTER.			
Bath of slag	1580	..	2876
Metal in ladle	1640	..	2984
" ingot mould	1580	..	2876
Ingot in reheating furnace	1200	..	2192
" under hammer	1080	..	1976
5. OPEN-HEARTH FURNACE (Siemens, Semi-Mild Steel).			
Fuel gas near generator	720	..	1328
Fuel gas entering into bottom of regenerator chamber	400	..	752
Fuel gas issuing from regenerator chamber	1200	..	2192
Air " " " "	1000	..	1832
6. CHIMNEY GASES.			
Furnace in perfect condition	300	..	590
7. OPEN-HEARTH FURNACE.			
End of the melting of pig charge	1420	..	2588
Completion of conversion	1500	..	2732
8. MOLTEN STEEL.			
In the ladle—commencement of casting	1580	..	2876
" " —end of casting	1490	..	2714
In the moulds	1520	..	2768

For very mild (soft) steel the temperatures are higher by 50 degrees Celsius.

9. SIEMENS CRUCIBLE OR POT FURNACE	1600	..	2912

Determinations by Prof. Le Chatelier (Continued).

	° C.		° F.
10. ROTARY PUDDLING FURNACE	1340-1230	..	2444-2246
Puddled ball—end of operation	1330	..	2426
11. BLAST FURNACE (Gray-Bessemer Pig).			
Opening in face of tuyere	1930	..	3506
Molten metal—commencement of fusion	1400	..	2552
" " —end, or prior to tapping	1570	..	2858
12. RED-BRICK KILN (Hoffmann's).			
Burning temperature	1100	..	2012
13. FOUNDRY IRONS AND STEELS.			
Melting heat of white cast-iron	1135	..	2075
" " gray " "	1220	..	2228
" " mild steel	1475	..	2687
" " semi-mild steel	1455	..	2651
" " hard steel	1410	..	2570
14. PORCELAIN FURNACE (for Hard Porcelain).			
Heat at the end of baking	1370	..	2498
15. INCANDESCENT LAMPS.			
Heat, burning normally	1800	..	3272
" when pushed	2100	..	3812

Effect of Heat Upon Various Bodies.

(From Haswell and Other Sources.)

Absolute zero of temperature	—273° C.
Hydrogen under 180 atm. liquefies at	—205° F.
Nitrous oxide freezes	—150
Boiling point of liquid ozone at atmospheric pressure	—119
Greatest natural cold	— 56
Liquid ammonia freezes at	— 46
Sulphuric ether freezes at	— 46
" " (spec. gr. 1.641) freezes	— 45
Nitric acid (spec. gr. 1.424) "	— 45
Proof spirit and brandy freeze	— 7
Snow and salt, equal parts	0
Spirits of turpentine freezes	+ 14
Strong wines freeze	20
Human blood freezes	25
Sea-water "	28
Vinegar "	28
Milk "	30
Olive oil "	36
Vineous fermentation	60–77
Acetous " begins	78
Acetification ends	88
Heat of human blood	98
Highest natural temperature in Egypt	117

Effect of Heat Upon Various Bodies (Continued).

(From Haswell and Other Sources.)

Gutta-percha softens	145° F.
Gutta-percha vulcanizes	293 "
Petroleum boils	306 "
Wood, dried, burns	340 "
Mercury volatizes	680 "
Ignition of bodies	750 "
Heat of common fire	790 "
Combustion of bodies	800 "
Charcoal burns	800 "
Air furnace	3300 "
Fire-brick melts	4000–5000 "

Different Colors of Iron Caused by Heat.

(Pouillet.)

°C.	°F.	Characteristic.
261	502	Violet, purple and dull blue. Between 261° C. and 370° C. it passes to bright blue, sea green, and then disappears.
370	680	
500	932	Commences to be covered with a light coating of oxide, becomes a deal more impressible to the hammer, can be twisted with ease.
525	977	Becomes nascent red.
700	1292	Sombre red.
800	1472	Nascent cherry.
900	1657	Cherry.
1000	1832	Bright cherry.
1100	2012	Dull orange.
1200	2192	Bright orange.
1300	2372	White.
1400	2552	Brilliant white; welding heat.
1500	2732	Dazzling white.
1600	2912	

Temper Colors of Steel.

(Haswell.)

°C.	°F.	
221	430	Faint yellow.
238	460	Straw color.
243	470	Dark straw.
277	540	Purple.
289	550	Blue.
293	560	Full blue.
304	580	Polish blue.
316	600	Dark blue.
400	752	Bright red in the dark.
474	884	Red hot in twilight.
581	1077	Red, visible by day.

Metal Baths for Tempering.

(Molesworth.)

	Pb.	Sn.
Turning tools for metals	1.75	1
Wood tools, taps and dies	2.5	1
Hatchets, chipping chisels	4.75	1
Springs	12	1

Melting Points of Metals.

1. COMMON COMMERCIAL METALS.	Degrees Fahrenheit.
Aluminum	1157*
Antimony	from 810† to 1150c
Bismuth	" 476h " 512p
Copper	" 1929* " 1996c
Lead	" 608h " 618*
Mercury	39
Tin	" 442c to 451p
Zinc	" 680† " 779*

2. COMMON COMMERCIAL ALLOYS.	
Yellow brass	?
Bronze	1690c

3. SOME OF THE RARER METALS.	
Arsenic	365h
Calcium	at full red heat ?
Cadmium	442k
Lithium	356h
Magnesium	1200k
Potassium	from 136r to 144k
Sodium	" 194 " 208k
Tungsten, Chromium,	not fusible in forge, but soften and agglomerate ?

4. THE IRON GROUP AND COMMERCIAL IRONS.	
Iron, gray	from 2030 to 2280m
" white	" 1190m " 2075*
" wrought	" 2700h " 2912p
" fero-silicious	" 2040 " 2190m
" malleable	" ?
Steel, 1.18—1.32 C	" 2350 " 2450m
" hard	2570*
" mild	2687*
" ferro manganese	" 2210 " 2255m
" ferro-tungsten	" 2240 " 2280m
" ferro-chrom	" 2180 " 2400m
Cobalt,	2000s
Nickel,	fusible in highest heat of a forge 2732s
Magnesium,	?

5. PRECIOUS METALS.	
Gold, pure	from 1913* to 2282†
" standard	2156c
Silver, pure	" 1773* " 1873k
Platinum, fusible only before the oxyhydrogen blowpipe	3227*
Palladium	2732*
Rhodium	?
Iridium, fusible only before the oxyhydrogen blowpipe	?

References:

r. = Regnault.
s. = Steele's Handbook.
c. = D. K Clark's Handbook.
* = Prof. Roberts Austen.
† = Pouillet
k = Kent's Handbook.
m = Dr. R. G. G. Moldenke.
h = Haswell's Handbook.
p. = Person.

Melting Points of Lead—Tin Alloys.

(KENT.)

1 Tin, 25 Lead	292° C. =	558° F.
1 " 10 "	283 "	541 "
1 " 5 "	266 "	511 "
1 " 3 "	250 "	482 "
1 " 2 "	cheap solder	227 "	441 "
1 " 1 "	common solder	188 "	370 "
1½ " 1 "	168 "	334 "
2 " 1 "	fine solder	171 "	340 "
3 " 1 "	180 "	356 "
4 " 1 "	185 "	365 "
5 " 1 "	192 "	378 "
6 " 1 "	194 "	381 "

Melting Points of Fusible Plugs.

(HASWELL.)

2 Tin, 2 Lead	Soften at	185° C. =	365° F.,	melt at	189° C. =	372° F.
2 " 6 "	"	189 "	372 "	"	195 "	383 "
2 " 7 "	"	192 "	377½ "	"	197 "	388 "
2 " 8 "	"	202 "	395½ "	"	209 "	408 "

Melting Points of Solders.

(KENT.)

Description.	Tin.	Lead.	Gold.	Silver.	Copper.	Brass.	Zinc.	Nickel	Bismuth	Melting Points.
Common solder.	1	1	..	...	....	...	..	.....	....	.....188° C., 370° F.
Fine solder.....	2	1	..	...	....	...	..	....	....	... ...171 " 340 "
Cheap solder...	1	2	..	...	....	...	..	.....	....	.....227 " 441 "
Gold solder.....	..	..	14	6	4	...	..	.....	....	Undetermined.
Gold solder, for 14-carat gold.	....	..	25	25	.....	12½	1	.....	....	
Silver solder ...	11½	..	..	...	....	70	7	.. ..	....	
" " ...	....	..		145	.....	73*	4	.....	....	
German S.solder	...	..	..	...	38	54	..	8	....	
Novel's solder for aluminum	100	5	..	...	....	...	..	.....	...	280–300° C., 536–572° F.
	100	..	..	...	.....	5	..	.....	....	280–300 " 536–612 "
	1000	..	..	...	10–15	...	..	.....	....	350–450 " 662–842 "
	1000	..	..	...	....	...	..	10–15	....	350–450 " 662–842 "
Novel's solder, for aluminum bronze.....	900	..	..	...	100	...	..	.....	2–3	Undetermined.

* Yellow brass, consisting of 3 copper and 1 zinc.

Melting Points of Fusible Alloys.

Lead.	Tin.	Bismuth.	Zinc.	Cadmium.	Mercury.	Description.	Melting Points.
25	25	50	.....	.....	250	D'Arcet's..	113° F.
20.55	21.10	50	.....	14.03	.....	Guthrie's "Entectic," very low	?
25	12 50	50	.. ...	12.50	.....	Wood's	149 "
26	12.78	50	.....	10.40	.....	Lipowitz's	149 "
1	1	4	.....	1	....	Quoted by Haswell.....	155 "
25	12	50	.....	13	.....	" "	150-160 "
19.36	19.97	47.38	. .. .	13.29	.....	Guthrie's "Cadmium".....	160 "
2	1	4	.....	1	.....	Wood's.....	165 "
3	2	5	.....	.....	.....	Stereotype writing pencils..	199 "
33.3	....	33.4	33.3	.....	.....	Quoted by Haswell, less than	200 "
1	1	2	.....	.....	.....	Rose's.....	200 "
25	25	50	.....	.....	.....	D'Arcet's.....	201 "
1	1	4	.....	.. ...	.....	Quoted by Kent and Clark.	201 "
5	3	8	.....	.....	.....	" "	202 "
.....	3	5	.....	.. ...	....	" "	202 "
31.25	18.75	50	.....	.....	.....	Newton's.....	202 "
28 10	24.10	50	.....	... ..	.....	Rose's.....	203 "
3	5	8	.....	.....	.....	Quoted by Kent.....	208 "
1	3	5	.....	.. ...	.....	" Haswell.....	210 "
31	19	50	.....	.....	.....	Newton's, quoted by Haswell. ..... less than	212 "
3	2	5	.....	.. ..	.....	Newton's.....	212 "
2	3	5	.....	.....	....	Quoted by Haswell	212 "
1	4	5	.....	.....	....	" Kent & Haswell.	240 "
1	1	1	.....	.....	.....	" Clark	254 "
1	2	1	.....	.....	.....	Pewter's solder & soap moulds	?
1	.....	1	.....	.. ...	.....	Quoted by Kent.....	257 "
... ..	1	1	.....	.....	.....	" " and Haswell	286 "
2	2	1	.....	.. ...	.....	" Clark	292 "
4	4	1	.. ...	.....	.....	" "	320 "
.....	2	1	.....	.....	.....	" Kent & Haswell.	336 "
.....	3	1	. ...	.....	.....	" "	392 "
.....	1	.....	1	.....	.....	" Haswell.....	399 "

Melting Points of Miscellaneous Substances.

(From Various Sources.)

Sulphurous acid.....	—148° F.
Carbonic acid.....	—108 "
Bromine.....	— 9.5 "
Turpentine.....	14 "
Hyponitric acid.....	16 "
Ice.....	32 "
Nitro-glycerine...	45 "
Pitch ..	91 "
Tallow.....	92 "
Lard.....	95 "
Phosphorus	112 "

Melting Points of Miscellaneous Substances (Continued).

(From Various Sources.)

Acetic acid	113°	F.
Stearine	109–120	"
Spermaceti	120	"
Margaric acid	131–140	"
Bees-wax, rough	142	"
" bleached	154	"
Stearic acid	158	"
Iodine	225	"
Sulphur	239	"
Saltpetre	606	"
Potassium sulphate	1859	"
Glass	2377	"

Boiling Points of Various Substances at Atmospheric Pressure.

14.7 Lbs. per Square Inch.

(From Various Sources.)

Ether, sulphuric	100°	F.
Carbon bisulphide	118	"
Ammonia	140	"
Chloroform	140	"
Bromine	145	"
Wood spirit	150	"
Alcohol	173	"
Benzine	176	"
Naphtha	186	"
Water	212	"
Milk	213	"
Average sea-water	213.2	"
Carbonate of Soda, saturated	220.3	"
Acetate of Soda, "	225.8	"
Saturated brine	226	"
Nitrate of Potash, saturated	240.6	"
Nitric acid	248	"
Nitrate of Soda, saturated	250	"
Carbonate of Potash, "	275	"
Petroleum	306	"
Oil of Turpentine	315	"
Petroleum, rectified	316	"
Coal tar	325	"
Acetate of Potash, saturated	336	"
Phosphorus	554	"
Sulphur	570	"
Sulphuric acid	590	"
Linseed oil	597	"
Whale oil	630	"
Mercury	676	"
Lead	about 1500	"
Zinc	1872	"

Suitable Temperatures

FOR

Annealing steel		900–1300° F.
" malleable iron (furnace iron)		1100–1400 "
" " " (cupola iron)		1500–1700 "
" glass (initial temperature)		950 "
Working "		1200–1475 "
Melting " (into a fluid)		2200 "
Hardening tool steel		1200–1400 "
Case-hardening iron and soft steel		1300–1500 "
Core ovens in foundries		350 "
Drying kilns for wood		300 "
Baking white enamel,	Bicycle paint,	150 "
" red and green enamel,	Bicycle paint,	250 "
" black enamel,	Bicycle paint,	300 "
Vulcanizing rubber		295 "

Drawing the Temper of Tools.

(Rose and Kent.)

Scrapers for brass.	Very pale yellow, 430° F.	Hand plane irons.	
Steel-engraving tools.		Twist drills.	
Slight-turning "		Flat drills for brass.	
Hammer faces.		Wood-boring cutters.	
Planer tools for steel.		Drifts.	
Ivory-cutting tools.		Coppersmiths' tools.	Light purple, 530° F.
Planer tools for iron.		Edging cutters.	
Paper cutters.		Augers.	
Wood-engraving tools.		Dental and surgical instr.	
Bone-cutting tools.		Cold chisels for steel.	Dark purple, 550° F.
Milling cutters.	Straw yellow, 460° F.	Axes.	
Wire-drawing dies.		Gimlets.	
Boring cutters.		Cold chisels for cast-iron.	
Leather-cutting dies.		Saws for bone and ivory.	
Screw-cutting dies.		Needles.	
Inserted saw teeth.		Firmer chisels.	
Taps.		Hack saws.	
Rock drills.		Framing chisels.	
Chasers.		Cold chisels for wrought iron.	
Punches and dies.		Moulding and planing cutters.	
Penknives.		Circular saws for metal.	
Reamers.		Screw-drivers.	
Half-round bits.		Springs	
Planing and moulding cutters.	Brown yellow, 500° F.	Saws for wood.	Dark blue, 570° F.
Stone-cutting tools.			Pale blue, 610° F.
Gauges.			Blue-green, 630° F.

Above list is arranged in the order of the color scale as it appears on bright steel when heated in the air.

TESTIMONIALS.

CLEVELAND, OHIO, January 18, 1897.

CHAS. ENGELHARD, NEW YORK.

Dear Sir: We are in receipt of your favor of the 14th inst., and beg to state that our experience with the Pyrometer received from you has been very satisfactory. We are able now to determine definitely the exact degree of heat in our case-hardening ovens; consequently, we are able to turn out work of uniform degree of hardness.

Yours truly,
WHITE SEWING MACHINE COMPANY.
(Signed) GEO. O. SIMONDS.

THE CARNEGIE STEEL COMPANY, LIMITED,
THE EDGAR-THOMSON STEEL WORKS AND FURNACES,
BRADDOCK, PA., May 22, 1899.

MR. CHARLES ENGELHARD,
41 Cortlandt Street, New York City.

Dear Sir: In reply to your esteemed favor of the 20th inst., I received your new edition of the pamphlet describing your Pyrometer, with many thanks.

I take great pleasure in attesting that your Pyrometer has given satisfaction. We were anxious to determine the temperature of steel rails while in the process of rolling. With the use of the Electro Pyrometer received from you, we have been able to satisfy all our requirements

Yours truly,
(Signed) R. STEVENS.

THE AMERICAN BALL-BEARING COMPANY,

CLEVELAND, OHIO, May 19, 1899.

MR. CHARLES ENGELHARD,

41 Cortlandt Street, New York.

Dear Sir: Your letter of the 16th inst. and catalogue received. In reply to your favor, we are pleased to advise that we now consider the Pyrometer, purchased of you two years ago, one of the necessities of our plant.

We have placed this instrument on an independent foundation in our office, and, by means of a telescopic arrangement, the men operating our furnaces at the other end of factory are also enabled to take readings at a distance of several hundred feet.

We can safely recommend the merits of this instrument to any one desiring such a device.

Yours very truly,

(Signed) THE AMERICAN BALL-BEARING CO.,

Per FRED C. DORN, Treasurer.

INDIANAPOLIS CHAIN AND STAMPING COMPANY,

INDIANAPOLIS, IND., June 16, 1899.

MR. CHARLES ENGELHARD, New York, N. Y.

Dear Sir: Yours of the 12th inst. and pamphlet received. Thanks for same. We are very much pleased with the Pyrometer you furnished us.

Yours truly,

INDIANAPOLIS CHAIN AND STAMPING COMPANY.

ROOKWOOD POTTERY,

CINCINNATI, OHIO, July 29, 1899.

MR. CHARLES ENGELHARD,

41 Cortlandt Street, New York.

Dear Sir: We presume our telegram of last night, requesting you to ship one element by express to-day, has been received, and that you have given the order attention.

As you may judge by our repeated orders, we are really pleased with our experience with this device and consider it the best which we have ever tried for the delicate regulation of kiln firing.

Yours very truly,

(Signed) THE ROOKWOOD POTTERY COMPANY,
W. W. TAYLOR, President.

UNION GLASS COMPANY,

SOMERVILLE, MASS., November 23, 1900.

MR. CHARLES ENGELHARD,
41 Cortlandt Street, New York, N. Y.

Dear Sir: The Pyrometer that we have is working so well that we have decided to purchase another, so that if you will kindly forward us one galvanometer by express, we should appreciate same.

Trusting you will give this your immediate attention, we remain,

Very truly yours,

(Signed) UNION GLASS COMPANY,
WM. S. BLAKE, Treasurer.

Confirming telegram—"Send one Galvanometer by express."

INTERNATIONAL CEMENT COMPANY,

PITTSBURG, PA., July 3, 1901.

MR. CHARLES ENGELHARD, New York.

Dear Sir: Your favor of May 21 came to hand some time ago, and would have been answered promptly but at that time our Cement Company was not formed. It is now formed and will be known as shown at head of this sheet. We value your Pyrometer very much and have found it quite useful in our experiments.

Yours very truly,

(Signed) J. B. GRAHAM, President.

INTERNATIONAL CEMENT COMPANY,

PITTSBURG, PA., July 6, 1901.

MR. CHARLES ENGELHARD, New York.

Dear Sir: Answering yours of 5th inst., would say you are at liberty to use our opinion of your Pyrometer as you see fit. We consider it of great value in our business and would not care to be without it.

Yours very truly,

(Signed) J. B. GRAHAM, President.

PERTH AMBOY TERRA-COTTA COMPANY,

N. Y. Office, 160 Fifth Ave.

PERTH AMBOY, N. J., July 31, 1901.

MR. CHARLES ENGELHARD,

41 Cortlandt Street, New York.

Dear Sir: We have to acknowledge your favor of the 30th inst. We are entirely satisfied with the working of the Heraeus Le Chatelier Pyrometer, and are procuring valuable results. We shall not require another one, however, at present.

Yours truly,

(Signed) PERTH AMBOY TERRA-COTTA COMPANY,

OSWALD SPEIR, Assistant General Manager.

BERLIN, May 23, 1896.

We take great pleasure in attesting that your Pyrometer, as used by us, has fully satisfied our expectations.

We remain, very respectfully,

GENERAL ELECTRIC COMPANY,

(Incandescent Lamp Factory.)

(Signed) BUSSMANN.

TERRA-COTTA FACTORY,
MERZIG-ON-THE-SAAR, MAY 15, 1896

In reply to your esteemed favor of the 6th inst., we can cheerfully reply that the Galvano-Pyrometers secured from you have been in constant use in our factory for the last three and one-half months and have given good satisfaction.

They indicate with exactness all temperatures up to white heat.

We have compared the instruments with all other heat-measuring appliances which were at our disposal and have found them to compare very well with each other, etc.

Very respectfully,

VILLEROY & BOCH,

(Signed) SPANGENBERG.

DUISBURG, May, 1896.

The Electro-Pyrometer constructed by you and Messrs. Keiser & Schmidt, Berlin, has been used in my establishment for three-quarters of a year, and I can highly recommend the same from own experience.

It works very exact and indicates the correct degree of temperature immediately, when the necessary connections are made.

No disturbances have occurred up to date; the apparatus performs its work faultlessly, when the necessary precautions are observed in placing and adjusting the same, and if it is placed in a perfectly horizontal position.

Very respectfully,

FRIEDRICH CURTIUS.

(Sulphuric Acid and Soda Factory.)

FRANKFORT-ON-THE-MAIN, November 30, 1895.

The Pyrometer secured from you some time ago has given excellent satisfaction, though slight difficulties were experienced on account of the porcelain tubes.

The instrument is easily handled and is adapted for universal use.

We use the Pyrometer for measuring temperatures in crucibles, crucible furnaces, muffles, smelting furnaces, etc.

The microvoltmeter, which is well regulated and entirely astatic, gives exact results in any position, provided the needle swings freely. It has been placed on a shelf in our weighing room, where it is not exposed to shocks, and conductors lead from here to the various stations where temperatures are to be measured.

The prompt return of the pointer to zero permits a number of various measurements in quick succession by switching the different elements off and on to the voltmeter.

Our experience leads us to believe that it is not advisable to leave the instrument connected for any length of time, and neither is this necessary, as the correct temperature is given immediately when switched on.

Various thermo-elements procured by us at different times compared favorably with each other, and the results obtained removed any doubts we may have had regarding the possibility of constructing them uniformly.

We possess all the necessary instruments for recalibrating the microvoltmeter, but we had no occasion to make use of any of them.

Your Pyrometer should be an instrument to satisfy all requirements of the industries, if it can be avoided to enclose the porcelain tubes in iron pipes to protect same from injury.

Very respectfully yours,

GERMAN GOLD AND SILVER REFINERY WORKS,

(Formerly Roessler Technical Division.)

(Signed) JOH. PFLEGER.

MALSTATT, NEAR SAABRÜCKEN, May 21, 1896.

We herewith desire to state that, for some time, we have made practical use of the electro-thermometer furnished us by Messrs.

Keiser & Schmidt, Berlin, for the purpose of determining the temperature in flues of boilers of various construction.

The application of the apparatus is very convenient, and the results obtained therewith are reliable.

Very respectfully,

C. H. BOECKING & DIETSCH.

(Cement Factory.)

[This is one of the largest cement factories in Germany.]

JENA, September 26, 1896.

The thermo-element sent us on trial has stood in a true sense of the word its fire test. We have used it uninterruptedly during the last three and one-half months for measuring temperatures of a very highly heated regenerative glass-melting furnace.

The porcelain tubes enclosing the wires projected into the furnace about twenty-five centimetres and rested on a fire-brick.

The instrument indicated instantly and correctly all changes and variations in the temperature caused by increased or decreased firing.

The needle of the galvanometer moved between 1,200 and 1,500 degrees within twenty-four hours; the highest temperature of the furnace was, therefore, 100 degrees more than the range of the scale.*

Very respectfully,

(Signed) DR. O. SCHOTT.

(Technical Glass Manufacturing Institute.)

HAGEN IN W., June 13, 1896.

In answer to your esteemed favor of the 11th inst., we beg leave to say that we are very well pleased with the Pyrometer procured from Messrs. Keiser & Schmidt during the early part of last December.

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*The above firm used an instrument with a scale divided up to 1,400 degrees Celsius. The scales of the present instruments are divided from 0 to 1,600 degrees Celsius.

The galvanometer is calibrated for our purpose, allowing the reading off of temperatures up to 600 degrees Celsius.

We use the instrument, from time to time, as a standard for testing the accuracy of other mechanical Pyrometers.

A test in our laboratory made with your instrument resulted more than satisfactory as to the accuracy of the temperature scale.

Very respectfully,

ACCUMULATOR MANUFACTURING COMPANY,

ppa. C. EMDEN.

The Royal Porcelain Factory, at Berlin, made the following statement of their experience in Nos. 51 and 52 of the *Thonwaaren Industrie Zeitung* (Pottery Journal).

Dr. Ebeling writes in No. 51 of this periodical: "The second instrument, as already stated in No. 44 of this publication, is preferable when used continuously for measuring high temperatures, on account of the small space it occupies.

"The heating of the junction of the two wires alone governs the indications of the instrument, and this particular point occupies a space of only a few cubic millimetres.

"It stands to reason that it must be protected by a porcelain tube when used directly in open flames, but even then the space it occupies in the furnace is much smaller than that occupied by other Pyrometers.

"It is especially valuable, as it can be used within great limits, reaching up to the melting point of platinum—about 1,800 degrees Celsius.

"Naturally there are special appliances required for the protection of the instrument if used at such high temperatures."

Dr. Hecht states as follows, in No. 52 of the same periodical: "It has been demonstrated in the foregoing, of how great a value the clay cones are to regulate the burning of pottery, and it has been shown likewise how unreliable, yes, I might say, 'how ridiculous,' it is to compare their melting points with degrees Celsius, but therewith I do not, by any means, intend to question the value

of the determination of temperatures in the pottery industry with the aid of this Pyrometer.

"If it does nothing else but show that, through the carelessness of the attendant, the temperature of the kiln has fallen fifteen degrees Celsius, its usefulness will be plainly demonstrated in economically managed plants. For this means that not only one and one-half hours' labor, but also considerable amount of fuel, is lost, which both are necessary to attain the former temperature.

"It would have effected the saving of this one and one-half hours of labor and the coal used during one and one-half hours' firing. By tracing a diagram, showing the progress of firing, we will find nearly always the evidence that the firing has not been done in a satisfactory manner.

"Another important factor in its favor is the exceedingly simple manner of handling the apparatus, and the possibility of measuring the heat produced, not only at the furnace itself, but at any convenient place; as, for instance, in the office. We can refer to the indications of such an instrument which we have placed on our desk, as a check, if the kiln is fired by the attendant according to his old custom by watching his clay cones, and his work can be controlled at any time at a great distance."

Dr. Bunte says, among others, in No. 24 of the *Journal für Gasbeleuchtung und Wasserversorgung* (Gas and Water Journal):

"We can obtain, with the greatest ease, a perfect illustration of the relative temperatures existing in an entire furnace system if we apply the Pyrometer at its various flues and at the firebox. Such data were heretofore only obtainable by spending much time and labor thereon. I had a great number of such measurements taken in Munich furnaces at the gasworks of Karlsruhe, and I have convinced myself therewith of the practical usefulness of the instrument."

Finally, we quote an extract from another statement made by the Royal Physical Technical Institute, at Charlottenburg:

"All these instruments (embracing all other instruments for measuring high temperatures that are on the market) have various drawbacks when compared with the thermo-element, some being less accurate and reliable, and others less simple to handle.

"A Pyrometer, to be of any practical value to the industries, must be constructed, in the first place, in such a manner that the temperature can be read off directly from a scale, so that an ordinary mechanic can make use of it.

"High temperatures must be unable to influence the correctness of the instrument, and it must give service for a reasonable length of time.

"Le Chatelier's thermo-element, in its new form, seems to give the most satisfactory results."